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EXHAUST EMISSIONS FROM SEVEN LP GAS POWERED VEHICLES

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National Air Pollution Control Administration
Ann Arbor, Michigan

July 1970

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16. Abstracts

An evaluation was undertaken of seven LP gas powered, standard sized American cars. The cars were equipped with V-8 engines, automatic transmissions and Algas Industries dual fuel carburetion systems. Each car was tested according to the proposed 1972 Federal procedure, which includes a cold start, the LA4-S3 driving schedule, and emission sampling by the CVS method. Results from these tests are presented for each car as mass emissions. The cars were then taken through a hot-start two-cycle test according to the 1970 Federal procedure, with the CVS method being employed in addition to the continuous sampling. Data from these two hot seven mode cycles are presented as (1) concentrations and mass emissions as calculated by the 1970 procedure, and (2) mass emissions calculated from the CVS procedure. The results are presented and discussed. Test data are presented in tabular form.

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Cold start
Driving schedule
Constant volume sampling
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1970 Federal procedure

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Subject: Evaluation of LP Gas powered automobiles

Seven LPG powered cars were delivered to building 2042 by personnel of the St. Louis (Missouri) County Health Department, and tested here on June 9 and 10, 1970. The cars were all late model, standard sized American cars equipped with V-8 engines and automatic transmissions. None had air conditioning. All were equipped with Algas Industries dual fuel carburetion systems.

The fleet consisted of:

Three 1969 Dodge Coronet 4 door wagons (318 C.I.D.)
Two 1969 Rambler Rebel 4 door station wagons (343 C.I.D.)
One 1969 Plymouth Satellite 4 door sedan (318 C.I.D.)
One 1968 Ford Ranch Wagon 4 door station wagon (302 C.I.D.)

Evaluation Procedure

Each car was tested according to the proposed 1972 Federal procedure, which includes a cold start, the LA4-S3 driving schedule, and emission sampling by the CVS method. Results from these tests are presented for each car as mass emissions, i.e., grams of pollutant per vehicle mile (gpm).

Following the 1972 test a hot-start two-cycle test was made according to the 1970 Federal procedure, with the CVS method being employed in addition to the continuous sampling. Data from these two hot seven mode cycles are presented (1) as concentrations and mass emissions as calculated by the 1970 procedure, and (2) as mass emissions calculated from the CVS procedure.

Results and Discussion

Results from the 1972 procedure tests are presented in Table 1, along with the average values for each make of car (Plymouth and Dodge being considered as one make). Note that repeat tests were made of Dodges 23 and 30 after mixture adjustments were made by Mr. Ralph Abbott of Algas Industries. Continuous hot cycle measurements indicate that idle CO was in the range of 2 to 3 percent on these cars before adjustment, and about .02 percent after. A third car, Rambler Rebel 29, had a high CO mass from the 1972 test and an idle CO of about 2.7% on the hot California cycles. Idle CO on the other cars ranged from 0.5% to 1.5%.

Mass emissions from 1972 procedure tests conducted at DMVPC recently using gasoline were picked at random from the files, four tests for each vehicle type similiar to the St. Louis County vehicles. The averages of these four tests are listed in Table III according to car make. All Plymouth and Dodge tests were of 318 C.I.D. engines, but it was not possible to find all Ford 302 and Rambler 343 data. However, all were late model V-8's with automatic transmission.

Comparison of Table I data with Table III data indicates the chief advantage of LP Gas powered cars: good control of carbon monoxide, with an average CO reduction of 71% being shown in this comparison. Average HC reduction was 18.4% and average NO_X reduction was 28.6%.

Table II contains the results of the two hot seven mode cycles, calculated according to the 1970 Federal procedure and presented as concentrations and mass emissions. Simultaneous CVS mass emissions for the last three tests are also presented.

For comparison with Table II concentrations some hot cycle data from DMVPC certification and surveillance tests (using gasoline) are presented in Table IV. Five tests for each car/engine combination matching the St. Louis County vehicles were picked at random from the files.

Driveability during tests was typical of lean operation, with slight hesitation on tip-in, stretchiness on accelerations, and surging during cruise.

Table I

1972 Proposed Federal Procedure
(Cold Start)

Car Number	Mass, grams/mile HC (FID)	CO	NO_X
Dodge 23	2.92	39.4	3.59
Dodge 30	3.03	36.78	2.39
Rebel 29	2.69	24.52	2.29
Rebel 28	3.26	6.20	2.95
Dodge 23	2.04	2.43	2.78
Dodge 30	2.71	18.85	2.04
Plymouth 27	2.47	3.66	3.39
Dodge 24	2.21	3.86	3.32
Ford 26	2.41	4.23	1.78
Average Values			
Ford	2.41	4.23	1.78
Plymouth & Dodge [1]	2.36	7.20	2.88
Rebel	2.98	15.36	2.62

[1] First tests of Dodges 23 and 30 excluded.

Table II

2 HOT SEVEN MODE CYCLES

	1970 Federal Procedure (Continuous Analysis)						Constant Volume Sampling (CVS) Procedure		
	Concentration			Mass, grams/mile			Mass, grams/mile		
Car Number	HC ppm	CO %	NO ppm	HC	CO	NO	HC	CO	NO_X
Dodge 23	200.0	0.25	1808.9	2.54	5.78	7.05	No Data		
Dodge 30	275.1	1.35	740.4	3.49	31.16	2.89	No Data		
Rebel 29	213.5	0.78	727.7	2.71	17.96	2.83	No Data		
Rebel 28	305.5	0.32	889.6	3.87	7.43	3.47	No Data		
Dodge 23	287.7	0.07	1097.9	3.65	1.65	4.28	No Data		
Dodge 30	272.1	0.37	983.2	3.45	8.46	3.83	No Data		
Plymouth 27	313.0	0.23	1466.5	3.61	5.05	5.22	2.86	4.22	3.08
Dodge 24	236.2	0.22	1362.3	2.99	4.95	5.31	1.99	3.25	2.93
Ford 26	291.3	0.28	582.8	3.97	7.11	2.44	3.63	5.89	1.83

Table III

1972 Proposed Federal Procedure
(Cold Start)

Average of Four Tests Each
Gasoline Powered Vehicles

Car Make	Mass, grams/mile HC	CO	NO_X
Ford	3.12	28.46	3.58
Plymouth & Dodge	3.39	30.45	3.63
Rambler	3.04	31.47	3.08

Table IV

Certification and Surveillance Data

2 Hot Seven Mode Cycles

	HC ppm	CO %
Ford 302		
	191	0.46
	211	1.03
	200	.72
	194	.66
	242	.53
Average	208	0.68
Plymouth & Dodge 318		
	151	.38
	202	.30
	177	.50
	222	.19
	126	.36
Average	176	.35
Rambler 343		
	193	.72
	201	1.07
	193	.48
	163	.53
	190	.93
Average	188	.75